A1367 – A CLUSTER IN FORMATION

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I. Introduction

A1367 is a puzzling cluster with a large elongation, suggesting a major merger but with an anti-correlation between the luminosity and temperature of the two components of the cluster (NE and SW). The less luminous subconcentration appears hotter and the more luminous portion of the cluster appears cooler in contradiction to the well-established positive correlation of temperature and luminosity for clusters and groups. A1367 lies at the intersection of two large scale filaments in our local Universe - one in the direction of the Coma cluster and a second in the direction of the Virgo cluster. The elongation of the main X-ray structure lies along the Virgo-A1367 filament. With the XMM-Newton observation we have developed a model involving multiple mergers from two directions to explain the observed features of A1367.

II. X-ray Analysis

We previously performed initial imaging and spectral analyses for the A1367 XMM-Newton observations. Background subtracted, exposure corrected images were generated and a temperature map was derived from the MOS data using a technique developed by Churazov et al. (1996; Churazov, Gilfanov, Forman, \& Jones 1996 ApJ, 471, 673). The MOS map shows a wedge of cool gas extending from the brightest (main) part of the cluster towards the west in the direction of Coma cluster, along which lies the well-known Coma-A1367 filament. We suggest that this material, not fully virialized is flowing into the cluster from the filament.

The hotter region lying to the north of the main cluster gives the cluster its peculiarly large elongation. We suggest that a merger is underway and that a low density concentration is infalling from the northwest and that the reverse shock has heated this infalling material above the cluster virial temperature. Eventually this material will merge with the main cluster and the cool inflowing material from the east.

We have tried to extend our results with the PN analysis but have not succeeded. We carried out similar analyses (background subtracted, flat field images and various temperature maps, both binned and continuous) to those described above for the MOS, but the two detector sets do not give consistent spectral results for the faint surface brightness regions of the cluster.

III. Optical Galaxy Velocities

We extracted galaxy radial velocities from a large catalog and have used the velocities to explore the correspondence between X-ray features and optical galaxy overdensities. In the very large scale distribution of galaxy velocities, we find that A1367 lies at the intersection of two filaments - one in the direction of the Coma cluster and a second in the direction of the Virgo cluster. The elongation of the main X-ray structure lies along the Virgo-A1367 filament. In the Coma-A1367 direction, galaxies and low entropy gas are infalling from the northeast.

IV. Discussion

From the gas temperature and surface brightness maps, we have derived an approximate ``entropy map" (since the specific entropy can be expressed as $S=T/n^{2/3}$ we produce an entropy map by dividing the temperature map by the cube root of this surface brightness map since the surface brightness is crudely, the square of the gas density). The entropy map shows a large wedge of gas entering the southern part of the cluster from the east. The leading edge of the low entropy gas forms the bright, cool (low temperature) ridge that dominates the core of the main cluster. The

radio emission around the optically (and X-ray) bright galaxy 3C264 at the southern edge of the cluster shows the effects of tangential gas motions along the edge of the low entropy gas (the bright ridge). Two radio tails, originating within the NGC3862, bend sharply as they cross from the main cluster (hotter temperature) into the cooler gas forming the ridge. We suggest that the sharp bend results from the gas velocity differences as the cool, low entropy, merging gas, enters the core the main A1367 cluster.

In conclusion, A1367 derives its peculiar properties from merging along the two filaments which extend towards the main mass structures in our local Universe, the Coma and Virgo clusters. Each merging axis results in unique features of the cluster. The Coma cluster direction merger yields the reverse shock that heats the smaller infalling component to the northwest. The material infalling from the Virgo direction produces the cool low entropy ridge that dominates the appearance of the southern core and gives rise to the remarkable structure of the radio galaxy 3C264=NGC3862, the brightest cluster galaxy in the A1367 core.